

EWA Expenditures for Delta Smelt Protection

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Introduction

Purpose of this Paper

This report provides a detailed account of the environmental conditions encountered in 2001, the distribution of delta smelt in 2001, and the rationale for expending Environmental Water Account (EWA) assets, and the environmental conditions/benefits following those expenditures. Additionally, this paper provides conclusions and recommendations for EWA use in the future.

Environmental Water Account

An essential goal of the CALFED Program is to provide increased water supply reliability to water users while at the same time assuring the availability of sufficient water to meet fish protection and restoration/recovery. As a means to achieving this, the CALFED Agencies developed the EWA. The EWA focuses on resolving the fish/water diversion conflict at the Central Valley Project (CVP) and State Water Project (SWP) Delta export facilities by adopting an adaptive management approach to protect the fish of the Bay-Delta estuary through environmentally beneficial changes in CVP/SWP operations at no uncompensated water cost to the Projects' water users. This approach to fish protection requires the acquisition of alternative sources of project water supply, called "EWA assets."

In providing protection to delta smelt, these assets may be used to augment Delta flows (inflows and/or outflows), modify exports, and replace project water interrupted by the changes to project operations such that changing operations becomes easier. Having the ability to modify habitat conditions in the Delta in real-time as required, rather than relying solely on prescriptive standards, better affords protection to delta smelt and further allows these species to be placed on the road to recovery. It should be noted here that expenditures of EWA assets for delta smelt protection must be closely tied to the operations, or non-operation, of the south Delta temporary or permanent barriers in order to fully realize their benefits. Unlike salmonids, delta smelt receive no benefit from the barriers.

Delta Smelt

The delta smelt (*Hypomesus transpacificus*) was federally listed as a threatened species under the Endangered Species Act of 1973, as amended, on March 5, 1993. This osmerid fish species occurs only in Suisun Bay and the Sacramento-San Joaquin Delta, California. The abundance of

delta smelt has fluctuated a great deal in the past, but after 1981 began a precipitous decline. Over the past 30 years, the population has experienced a ten-fold decline in numbers, and since 1982, has remained at extremely low levels. This decline is due to: 1) reductions in outflow related to increased upstream storage and diversion of water from the Sacramento and San Joaquin Rivers and tributaries; 2) entrainment losses to water diversions at the Central Valley Project and SWP, through numerous small agricultural diversions throughout the Delta, and to power plants; 3) extreme high outflow years; 4) changes in food organisms, 5) toxic substances, including agricultural pesticides and heavy metals; 6) disease, competition, and predation; and 7) loss of genetic integrity through hybridization with (*Hypomesus wakasagi*) wakasagi (U.S. Fish and Wildlife Service, 1993). The recovery of delta smelt is important because they exist nowhere else in the world.

Tools

Several tools are used to provide information on the various life-stages of delta smelt, and the "real-time" abundance and distribution of the species in the Delta. For adult fish, these tools include: 1) Fall Mid-Water Trawl indices, 2) Spring mid-water trawl indices, 3), Beach seine sampling, 4) Chipps Island Trawl, and 5) Fish condition (gravid vs. spent). For larval delta smelt, these tools include: 1) Light trapping surveys and 2) 20 mm surveys. For juvenile fish, these tools include: 1) 20 mm surveys and 2) summer townet surveys. Tools common to all life stages include: 1) Hydrology (wet vs.dry), 2) X210cation, 3) Water quality and Water temperature, 4) rate of export, and 5) Salvage at the export facilities, although this "sampling" method is less effective for larval and early juvenile fish. All life stages of delta smelt are vulnerable to being captured by the CVP and SWP export facilities. During a large portion of their life cycle, delta smelt are either too small or not strong enough to avoid going through the louvers at the export facilities, and when they do, they likely do not survive.

After conducting the various surveys and obtaining the information from the "common" tools, the resulting data are integrated into the Delta Smelt Decision Tree (copy attached) to assess the level of concern for delta smelt in relation to their abundance and distribution in the Delta. The Delta Smelt Decision Tree outlines concerns likely to be encountered for each life stage of delta smelt, provides a means to assess those concerns in relation to the environmental conditions, and allows recommendations to be made based on interpretation of the above factors by the Delta Smelt Work Group. Using the most current information available along with the Decision Tree, the Delta Smelt Work Group makes recommendations to reduce exports, change Delta inflows and outflows, change barrier operations, and/or modify Delta Cross-Channel Gate operation.

Environmental Conditions/Smelt Situation in 2001

The export facilities began reporting delta smelt take in August 2000, however, numbers were low and no concerns were apparent.

February

The year was classified as Dry on February 15.

1. On February 12, the daily expanded salvage of delta smelt jumped from 12 to 207, indicating that adult delta smelt were likely moving to upstream spawning grounds. The daily expanded salvage continued to increase, confirming adult delta smelt were in the south Delta and some spawning was likely to occur there (figure 1).
2. An examination of salvaged delta smelt at the export facilities suggested that adult delta smelt could begin spawning soon. Because adult delta smelt are more environmentally important than larvae or juvenile delta smelt to the survival and recovery of the species, a concern existed to reduce the daily expanded salvage of these fish as well as avoid reaching the "red-light" take limit, as identified in the U.S. Fish and Wildlife Services' March 6, 1995, Biological Opinion on the Long-term Operation of the Central Valley Project (CVP) and the SWP.
3. On February 16, the Management Agencies requested export pumping be reduced to 7,000 cfs combined for five days (See attached Fish Action #5). This action was primarily to benefit winter-run chinook salmon but the DAT biologists believed that taking this action could have positive effects on reducing adult delta smelt entrainment at the facilities.
4. During the five day export reduction, the daily expanded salvage of delta smelt remained high but dropped from 213 to 126 on the 21st of February, immediately following the reduction. The Delta Smelt Workgroup, a multi-agency workgroup formed out of the Interagency Ecological Program, concluded that the reduction in exports led to the reduction in daily salvage of delta smelt at the export facilities. The total delta smelt salvage for the month of February was 3,768 (figure 2).

EWA Costs. The total EWA cost of this action amounted to approximately 52,000 acre feet (AF).

March

1. Daily expanded salvage of delta smelt increased to over 200 on February 25 and remained near this level until March 7th from the 8th to the 15th daily expanded salvage at the export facilities fluctuated around the 200 mark and then fell sharply on the 18th. Low daily salvage (under 120) was seen for the rest of March (figure 3). From the 6th through the end of March, the CVP was pumping solely to meet demands, as their portion of San Luis Reservoir was full, and pumped at relatively low levels (750 cfs to 1500 cfs). Demand did increase for the last five days of the month and pumping ranged from 2,000 cfs to 3,000 cfs. Clifton Court Forebay inflow accounted for the majority of the exports even during the first few days of the month when they were limited due to fish actions.

2. The Management Agencies requested export reductions at the SWP starting on February 27 and continuing through March 11 (See attached Fish Action #6). These reductions were taken primarily for winter-run salmon due to concerns with the National Marine Fisheries Service "red-light" take limit on winter-run chinook salmon.
3. On March 19th, the initial results of the first 20mm Survey of the year were reported. The data showed that most young of the year (YOY) delta smelt were centered around the confluence (figure 4). However, these early surveys are very definitive because the size of delta smelt at this time is so small, and net efficiency is low.

The data from the 20mm Survey showed the mean length of captured delta smelt was 7mm. The 14-day running average of delta smelt salvage at the export facilities was well below the 400 yellow light level but was approaching 200. Concern for delta smelt existed as described by a condition in the Service's March 30, 2001, biological opinion on the South Delta Temporary Barriers. The condition in the opinion is that when the 14-day running average exceeds 200, actions (reduced exports, modified flap-gate operation on the south Delta barriers, increase flows, etc.) to better conditions in the Delta for delta smelt are required. In past years, when the yellow light level was triggered, take at the export facilities was such that within a few days the red-light take level soon was hit. Salvage at the facilities showed that both YOY and adults were being taken.

4. The total delta smelt salvage for the month of March was 3,730, which is relatively low when compared to the authorized take level for a dry year (figure 2). The 14-day running average for delta smelt never met or exceeded the 200 pre-yellow light level. The Delta Smelt Workgroup believed that the reductions in SWP exports taken during the month of March, although not taken directly for delta smelt, had ancillary benefits to this species. These benefits were in the form of 1) reducing southerly in Delta channel flows, thus aiding in down-stream migration of juveniles to rearing grounds and up-stream migration of pre-spawning adults to spawning grounds, 2) reductions in entrainment at the export facilities via reduced exports, and 3) over-all improved Delta habitat conditions.

EWA Costs. The total EWA cost of this action amounted to approximately 65,000 AF.

April

1. The second 20mm Survey was completed and the third 20mm Survey had initial results reported by the 16th (figures 5 and 6). These data showed that the distribution of delta smelt were concentrated near Stockton along the San Joaquin River and then moved slightly downstream and towards Clifton Court Forebay. The data also showed that delta smelt were increasing in size and by mid month, the mean length was 10.58mm. Initial results of Survey 4 (figure 7) showed a broad distribution in the central and south Delta with a modest increase in mean length to 10.85.

On April 20, the Vernalis Adaptive Management Program (VAMP) began. Combined exports were held at 1,500 cfs and the San Joaquin target flow at Vernalis was 4,500 cfs. On April 26th, the Head of Old River temporary barrier was installed. The agricultural

barriers at Middle River and Old River near Tracy were installed with flap-gates closed. The Grant Line Canal barrier was installed with the center section and the flap-gates open as is the operation when the Head of Old River barrier is installed.

The daily expanded salvage at the export facilities for April never exceeded 80 fish and the 14-day running average for the month started at 65 and consistently decreased, reaching two by month's end.

2. Due to the low salvage numbers, concern for delta smelt was low (figure 8). The likely reasons for this low salvage were that most of the delta smelt were well below the size of identification/enumeration and export pumping was held at a combined 1,500 cfs.
3. The Management Agencies requested export reductions at the SWP on April 5 through April 9 in order to reduce take of spring-run chinook, San Joaquin fall-run chinook, and steelhead. The take of steelhead exceeded the authorized limit established by NMFS in the interim OCAP biological opinion. The Delta Smelt Workgroup believed that these reduced exports would also decrease entrainment of downstream migrating delta smelt that were spawned earlier in February.
4. As stated previously, the distribution of delta smelt broadened from the beginning of the month to the end of the month. Daily expanded salvage, as well as the 14-day running average of delta smelt, decreased steadily over the month. The total delta smelt salvage for the month of April was 519 (figure 2).

EWA Costs. Approximately 9,000 AF of EWA assets were used to reduce SWP exports for the VAMP. An additional 20,000 AF of EWA assets were used for salmonid and delta smelt protection from April 5 through April 9. From the results of the data, one could conclude that the use of EWA assets reduced entrainment at the export facilities and aided in increased distribution of delta smelt.

May

1. The beginning of May was relatively uneventful; combined exports remained at 1,500 cfs as VAMP continued, the 14-day running average was low, and the daily expanded salvage, although increasing, was not of concern (figure 9). On May 14, the 14-day running average for delta smelt exceeded 200. A pre-yellow light level of 200, half the "yellow light", was established in the March 30, 2001, biological opinion on the south Delta temporary barriers in order to begin taking actions to improve conditions in the Delta for delta smelt such that the "yellow" and "red-light" levels could be avoided. The Delta Smelt Work Group recommended tying the flap-gates open on the agricultural barriers and opening the culverts on the Head of Old River barrier in order to reduce barrier impacts to south Delta circulation patterns and increase emigration of delta smelt. DWR completed this task on May 16.

Initial results of the fifth 20mm Survey (figure 10) showed a decrease in the Catch per Unit Effort (CPUE) of delta smelt in the central and south Delta. Delta smelt were also

seen along the Sacramento River from Cache Slough south to the confluence of the Sacramento and San Joaquin rivers. The VAMP ended on May 20, 2001. The Head of Old River barrier was breached on May 26th. When the SWP closed the gates at Clifton Court Forebay on May 28th daily expanded salvage decreased mainly because no more delta smelt were entering Clifton Court Forebay.

2. In order to minimize entrainment of delta smelt, the Management Agencies requested that the export facilities maintain the combined exports at 1,500 cfs from May 21 until the end of the month. This was referred to as a "shoulder" on VAMP.
3. On May 21st, the I4-day running average for delta smelt exceeded the yellow light level of 400 and the daily expanded salvage increased sharply, exceeding 1,500. The rise in the daily expanded salvage and the tripping of the "yellow light" trigger raised concern for delta smelt.
4. The daily expanded salvage continued to increase as did the I4-day running average. On May 22, the Service requested that the barrier at Giant -Line Canal be breached in order to reduce entrainment and increase the hydrodynamics in the south and central Delta.

The Delta Smelt Work Group met towards the end of May to examine Particle Tracking Modeling (PTM) results (with and without the Grant Line Canal barrier and weighted by delta smelt distribution as determined from the 20mm Survey 5) to determine if the Grant Line Canal barrier should be breached (in order to alter south Delta hydrology). From the data provided by the modelers, the PTM results suggested that there would be no measurable change in delta smelt distribution and that entrainment in local agricultural diversions would offset any decreased entrainment at the export facilities. Based upon the input data and the subsequent results, it was concluded that breaching the Grant Line Canal barrier at that time would not provide a measurable benefit to delta smelt. The Department of Fish and Game requested that one additional flashboard in the Grant Line Canal barrier be removed so that more water could flow around the structure rather than over the top of the structure to better protect delta smelt. DWR agreed and removed the flashboard.

With the breaching of the Head of Old River barrier, flap-gates tied open on all barriers, the gates closed on CCF, and the shoulder on VAMP, delta smelt daily expanded salvage began to decrease from a high of 2,166 and continued to do so to the end of the month. The total delta smelt salvage for May was 13,278 (figure 2).

EWA Costs. The VAMP export reductions for the month of May resulted in an expenditure of approximately 34,000 AF of EWA assets. An additional 14,000 AF of EWA assets were used to place the "shoulder" on the VAMP.

June

1. The gates at Clifton Court Forebay began re-operation and combined exports were between 2,300 cfs and 3,300 cfs from June 1 through June 5, 2001. The Delta Smelt

Work Group met to examine DSM2 modeling runs regarding increased exports (combined 3,500 cfs) and agricultural barrier flap-gate operation. The modeling conducted showed no difference in the results with the agricultural barrier flap-gates held open versus tidal flap-gate operation, based on the then present distribution of delta smelt. The Delta Smelt Workgroup recommended no increased exports until the average size of delta smelt reached 30mm as determined by the 20mm Surveyor the summer townet survey. This recommendation was made in order to allow the delta smelt to reach an adequate size to better out-migrate to Suisun Bay.

A leak was identified in the California Aqueduct just downstream from the Banks Pumping Plant. As a result, DWR stopped radial gate operation at Clifton Court Forebay, however, combined export pumping remained at levels between 3,000 and 4,000 cfs through June 9 (figure 11). Reclamation scheduled additional pumping at Tracy to compensate for the reduction at Banks.

2. The 14-day running average for delta smelt remained above the "yellow light" level of 400 for the first five days of the month and on June 6 dropped below 400 and continued to decline for the rest of the month. A DAT call was initiated due to the SWP leakage and outage. Some diverters on Middle River were claiming water levels problems so the flap-gates on the barrier in Middle River were un-tied. The Delta Smelt Work Group met to discuss current trends. The 14-day running average continued to decline. Daily expanded salvage was at 102. The Work Group recommended that the flap-gates on the other two agricultural barriers be un-tied when the 14-day running average fell to levels below 200. The flap-gates were un-tied on June 14.
3. The Management Agencies requested that the SWP reduce exports for the first five days of the month due to the 14-day running average being over 400.
4. By reducing exports, and as a result of the SWP closing the gates to Clifton Court Forebay as a result of the leakage, the 14-day running average as well as the daily expanded salvage steadily fell to minimal levels by the end of the month. The total delta smelt salvage for the month of June was 2,454 (figure 2).

EWA Costs. The export reduction conducted during the first five days of the month resulted in an expenditure of approximately 9,000 AF of EWA assets.

Conclusions and Recommendations

The use of EWA assets to reduce exports at the CVP and SWP export facilities seemed to be a useful tool in minimizing entrainment of delta smelt (figure 2). Overall take of delta smelt for 2001 was far below the numbers authorized in the Service's 1995 OCAP biological opinion. One should note, however, that 2001 was an "easy" year (dry year conditions with low CVP/SWP exports) for delta smelt. This assumption stems from the relatively dry hydrology that was encountered in water year 2001 thus making EWA expenditures relatively affordable (exports were, for the most part, at relatively low levels, thus reducing exports further to assumed protective levels did not require the use of a lot of EWA assets), the relatively low abundance of

delta smelt as seen in monitoring and sampling efforts, and the fact that the SWP was shut down for maintenance during key delta smelt periods thus providing reductions in exports at no cost to the EWA.

A. Accomplishments during EWA implementation in water year 2001.

1. The Delta Smelt Workgroup utilized a structured process for evaluating data (delta smelt decision tree) and to assess conditions and formulate recommendations for EWA actions to benefit fish in water year 2001. Additional information was also obtained using Particle Tracking Modeling.
2. Staff of the Management and Project agencies and stakeholders communicated, cooperated, and coordinated effectively during water year 2001 to implement the EW A. This process occurred in DAT conference calls, the delta smelt workgroup, and in meetings with DWR staff modelers. This professional interdisciplinary team approach was evidence of a solid commitment to the EWA effort.
3. Through close coordination via the DAT conference calls and the delta smelt workgroup, the flap-gates on the temporary barriers were operated to provide hydrologic benefits to delta smelt while maintaining water supply to south Delta agriculture interests.
4. An extensive and reliable fish monitoring effort (20mm survey) enabled staff to identify relative abundance and distribution of delta smelt at various locations in the Sacramento - San Joaquin Delta area. This information helped staff to anticipate periods of heightened concern for delta smelt in the Delta and at the export facilities, thus allowing staff to make recommendations for export reductions.
5. A vast amount of biological, hydrological, and operational data was collected and made available to the DAT committee and the delta smelt workgroup to support the decision process for use of EWA assets. Without this critical foundation and the cooperation of colleagues and professional commitment to field crews and data management staff working throughout the Delta, we could not have implemented this program.
6. A comprehensive set of DAT conference call and delta smelt workgroup notes were compiled and reviewed in a timely fashion. The notes provided an excellent record of events and decisions made and that record, supplemented by the "fish action descriptions" documents, served well in recapping the entire EWA process in water year 2001.
7. The EWA was coordinated with management of the CVPIA 3406 (b)(2) water dedicated to fish and wildlife to provide expanded fish benefits and water supply reliability.
8. EWA assets were used to save delta smelt, Sacramento splittail, and other species of fish from direct loss to SWP export pumping and to reduce incidental take. For delta smelt, this resulted in keeping incidental numbers far from the red-light levels, as defined in the 1995 OCAP biological opinion.

9. The EWA process in water year 2001 was carried out in an open forum and raised the awareness of policy makers, managers, and the general public to the extreme challenge of balancing the use of our water resources.
10. Outreach with the media, general public and stakeholders who were not involved in the EWA decision process was fairly well conducted. Workshops on the concept of the EWA were held in five cities throughout California. Additionally, the use of EWA assets in water year 2001 was compared with delta smelt entrainment at the export facilities and the results reported at a Delta Smelt Workshop held at the University of California, Davis. The first EWA annual review workshop will be held in late October 2001.

B. Limitations encountered during EWA implementation in water year 2001:

1. Tier 3 EWA assets were not available in the first year of EWA implementation. Because of this, entrainment losses of winter-run chinook salmon suffered somewhat in order to reserve assets for delta smelt. Although this year proved to be an "easy" one for delta smelt as compared to years past and Tier 3 assets were not needed, we are likely to encounter more challenging years in the future when these assets will be required.
2. How ESA incidental take levels are determined and used has been unclear to some participants. A clearer understanding of this process and the quantitative rationale for targeting specific take levels is needed for the EWA process to be widely supported. It is also important to evaluate potential flexibility in ESA implementation to better enable field and laboratory experimentation to occur.
3. While making decisions to better afford benefits to delta smelt in real time, staff often found itself in a re-active mode rather than a pro-active one. To reverse this trend, a series of Particle Tracking modeling using various river flow rates, exports rates, and south Delta barrier configurations should be conducted up-front. This would provide a better idea of the steps needed to better protect delta smelt.
4. Our present inability to precisely determine the population size of delta smelt constrains our ability to place losses of these fish and the benefits of EWA actions into perspective.
5. Because some life stages of delta smelt have the ability to swim and "move like fish", it is difficult to adequately use and subsequently compare the results of Particle Tracking modeling to what might actually occur to delta smelt in the Delta.

C. Science needs for improved EWA implementation and evaluation:

1. Acquire a better understanding of how the Particle Tracking model relates to delta smelt movement and distribution.
2. Acquire a better understanding of how delta smelt are effected by the adverse effects of the south. Delta barriers and the entrainment that likely occurs through the un-screened agricultural diversions in the Delta.

3. Increased fish monitoring around the south Delta barrier sites in order to begin addressing the above two bullets.
4. Evaluate the effects of predators and the construction of shallow-water habitat on delta smelt in the south Delta.
5. Quantify additional ecosystem benefits of export reductions using CVP/SWP salvage data and other information.
6. Better coordinate the installation of the Head of Old River Barrier between salmon and delta smelt while at the same time reducing exports.
7. Define "Zone of Influence "and" Zone of Entrainment" and better incorporate these definitions into Particle Tracking modeling studies and EWA usage.
8. Determine the amount of "tweaking" required (flows, exports, barrier operations, etc.) in various modeling efforts in order to better identify the preferred outcome to delta smelt.
9. Use past years data and modeling results to relate trends to present year efforts.
10. Periodically review the Delta Native Fishes Recovery Plan to ensure that actions taken keep the target species on the "road to recovery".
11. Determine how much EWA water is likely to be needed to afford the desired level of protection of delta smelt and Sacramento splittail in each year and develop adequate EWA "place-holders" in each month from February through June (July and August as required).

D. Proposed changes in the methods of implementing the EWA:

1. Develop a comprehensive set of performance criteria to measure the effectiveness of using EWA water.
2. Determine if content of "fish action descriptions" documents is adequate and make modifications as needed.
3. Evaluate the DAT and delta smelt workgroup conference and note preparation process and modify as needed to improve the efficiency of staff time commitment and management level review of DAT and delta smelt workgroup recommendations.
4. Consider a EWA panel evaluation that evaluates both EWA and (b)(2) implementation in water year 2002.

5. Evaluate current fish sampling efforts and establish additional fish sampling stations and efforts to increase the accuracy and precision of fish abundance and distribution in the Delta.
6. Develop strategies to guide decisions that will consider the needs of all target species when EWA asset limitations come into play. Develop criteria for identifying circumstances when Tier 3 may be needed and establish a procedure for activating Tier 3 when any of the criteria are met.
7. Hold scientific workshops on specific topics relevant to EWA implementation in water year 2002. Workshops on conceptual models for delta smelt should continue.
8. Prioritize and implement key scientific studies important to EWA in water year 2002 based on above list of EWA science needs."

Literature Cited

- U.S U.S. Fish and Wildlife Service 1993. Endangered and threatened wildlife and plants; Determination of threatened status for the delta smelt. March 5, 1993. Fed. Reg. 58(42): 12854-12864.